UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

ADVANCE REPORT

on the

SEDIMENTATION SURVEY OF LAKE SPAVINAW

SPAVINAW, OKLAHOMA

June 18 - July 20, 1935

by

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Sedimentation and Hydraulic Studies.

SCS-SS-1
3-15-36

SEDIMENTATION IN LAKE SPAVINAW

SPAVINAW, OKLAHOMA

GENERAL INFORMATION

Location: State: Oklahoma

Counties: Mayes and Delaware

Distance and direction from nearest city: At Spavinaw, Oklahoma, 65 miles northeast of the city of Tulsa,

Drainage and backwater: Spavinaw Creek.

Ownership: City of Tulsa.

Purpose served: Municipal water supply.

Description of dam: The dam consists of a spillway section of reinforced concrete 880 feet long and 55 feet high, which is buttressed on the north against a 3700-foot earth dike containing a concrete core wall and faced with rip-rap on the upstream side. The elevation of the top of the spillway is 980.00 feet above mean sea level.

Date of completion: April (?) 1924.

Original length of lake: 5.45 miles

Present length of lake: 5.45 miles

Original area of lake:

1800 acres. Approximate figure supplied by the Tulsa Water Department.

Present area of lake:

1,637.64 acres, determined by this survey.

Original storage capacity at crest stage:

31,686 acre-feet or 10,326,467,400 gals. as determined by this survey. The original capacity estimated by the Tulsa Water Department was 21 billion gallons.

Loss of storage capacity due to silting/

Original capacity	31,686	acre-feet
Present capacity	30,509	" "
Loss	1,177	" "

Area of watershed: 400 square miles, as determined by the Tulsa Water Department.

General character of watershed:

The drainage basin of Lake Spavinaw lies in the western foothills of the Ozark Mountains in northwestern Arkansas and northeastern Oklahoma. It is underlain by formations of Mississippian and Devonian Age. Strata which outcrop in the immediate vicinity of the lake consist of black, very brittle shales overlain by fifty feet or more of dense, massive limestone which contains abundant chert in places.

Erosion of these alternating strong limestones and weak shale formations has produced a topography now in a state of early maturity. Along the drainage courses, slopes are steeply rounded with frequent abrupt breaks where the streams have been incised through massive zones of limestone. The small tributary valleys extending into the hills are often quite youthful in character. On the other hand, the major divides are sometimes broad and flat affording opportunity for farming.

The dominant soils of the watershed are members of the Baxter series,3/ which is developed mainly on the steeper slopes. The flatter uplands are covered by the Lebanon series, and the alluvial valleys by Huntington silt loam.

The Baxter soils consist of a light grayish-yellow A horizon, with a thin dark-colored layer at the surface, and a reddish-brown B horizon. These soils, occurring on the steeper slopes of the area, commonly have a poorly developed soil profile. Although they are comparatively young and not extensively leached, they are rather thoroughly oxidized due in part to the abundance of chert fragments and in part to their development on steeper slopes. The Baxter soils occupy, roughly, 75 percent of the area.

The soils of the Lebanon series consist of a pale grayish-yellow A horizon and a yellowish-brown B horizon that has a slight reddish shade, which becomes mottled with gray spots in

3/ 1. Marbut, C. F., Soils of the United States, Atlas of American Agriculture, U. S. D. A. Bureau of Chemistry and Soils, 1935, p. 29.

2. Marbut, C. F., Soil Reconnaissance of the Ozark Region of Missouri and Arkansas, Field Operations of the Bureau of Soils, 1911, U. S. D. A. Bureau of Chemistry and Soils, 1914, pp. 1727-1872.

the lower part, and finally grades downward into an indurated horizon at a depth ranging from 24 to 40 inches. These soils occupy the flat upland interstream areas and the ridge tops. They are mapped on the regional reconnaissance soil map as the Fayetteville series. (See footnote 3, reference 2) They have a concentration of stony material, which often forms a hardpan, within the first foot below the topsoil. This prevents both downward percolation and the upward rise of water, so that the soils may be equally droughty and poorly drained. The flatter areas are less productive than the slopes, and much land formerly in cultivation is now abandoned. These soils comprise about 20 percent of the area.

The valley soil is Huntington silt loam, which has a brownish surface soil and light-brown subsoil. It is the usual first-bottom soil of streams whose deposits of alluvium come from limestone areas. This soil comprises only about 5 percent of the total drainage area.

Erosion conditions in the watershed as shown on reconnaissance erosion maps of Oklahoma 4/ and Arkansas 5/ are as follows:

TYPE	PERCENT
1. Little or no erosion	26
2. Moderate sheet erosion	6
3. Moderate sheet erosion occasional gullies	28
4. Severe sheet erosion occasional gullies	33
5. Severe sheet erosion frequent gullies	7

The principal crops are corn, wheat and oats. In the upper portion of the watershed in western Arkansas, however, apple and peach orchards and vineyards are numerous. The total amount of land under cultivation is small. By far the larger percentage of land is in scrub timber including much grassland which is used for grazing. Approximate proportions of land-use are:

Agricultural (including orchards and vineyards)	15%
Open grazing land	5%
Scrub timber (including much grass)	80%

4/ Reconnaissance Erosion Survey of the State of Oklahoma: Scale 1/500,000. Soil Conservation Service, U.S. Dept. of Agriculture, 1934.

5/ Reconnaissance Erosion Survey of the State of Arkansas: Scale 1/500,000. Soil Conservation Service, U.S. Dept. of Agriculture, 1934.

Mean annual rainfall: 42 inches

Average draft:

During the summer months, the season of heaviest draft, the daily consumption averages 21,000,000 gallons.

HISTORY OF SURVEY

The survey of Lake Spavinaw was made during the period from July 18 to July 20, 1935, by the Midwestern Sedimentation Party, under the direction of Thomas L. Kesler, Chief of Party. The remaining personnel of the party consisted of L. M. Glymph, Jr., Assistant Chief, E. M. Flaxman, L. H. Barnes, H. L. Fischer, and O. D. Price.

Field work included establishing a primary triangulation net of 18 stations expanded from a base line along the earth fill section of the dam north of the spillway.

A total of 22 ranges was established and tied to the primary triangulation net. Soundings and direct silt measurement with spudding apparatus were made on each of these. For future reference, all range ends were permanently marked with numbered iron pipe set in concrete. In measuring surface areas, a previous map of the shore line was used, with minor readjustments. The upper end of the lake was completely remapped. The methods of computation used in determining capacity figures are described in the progress report for 1935 on silting of reservoirs now in the course of publication.

ACKNOWLEDGEMENTS

The Soil Conservation Service wishes to acknowledge the generous assistance of Mr. W. F. Graham, Commissioner of Water and Sewers, and of Mr. W. F. Anderson, Superintendent of the Tulsa Water Department. Their cooperation in furnishing boats, motors, fuel, lumber, pipe, and cement was of material assistance in expediting the survey. Mr. W. E. McMurray of Tulsa and Mr. Robert McReynolds of Spavinaw supplied valuable information relative to the original lake survey and watershed conditions.

CHARACTER, VOLUME AND DISTRIBUTION OF SEDIMENT

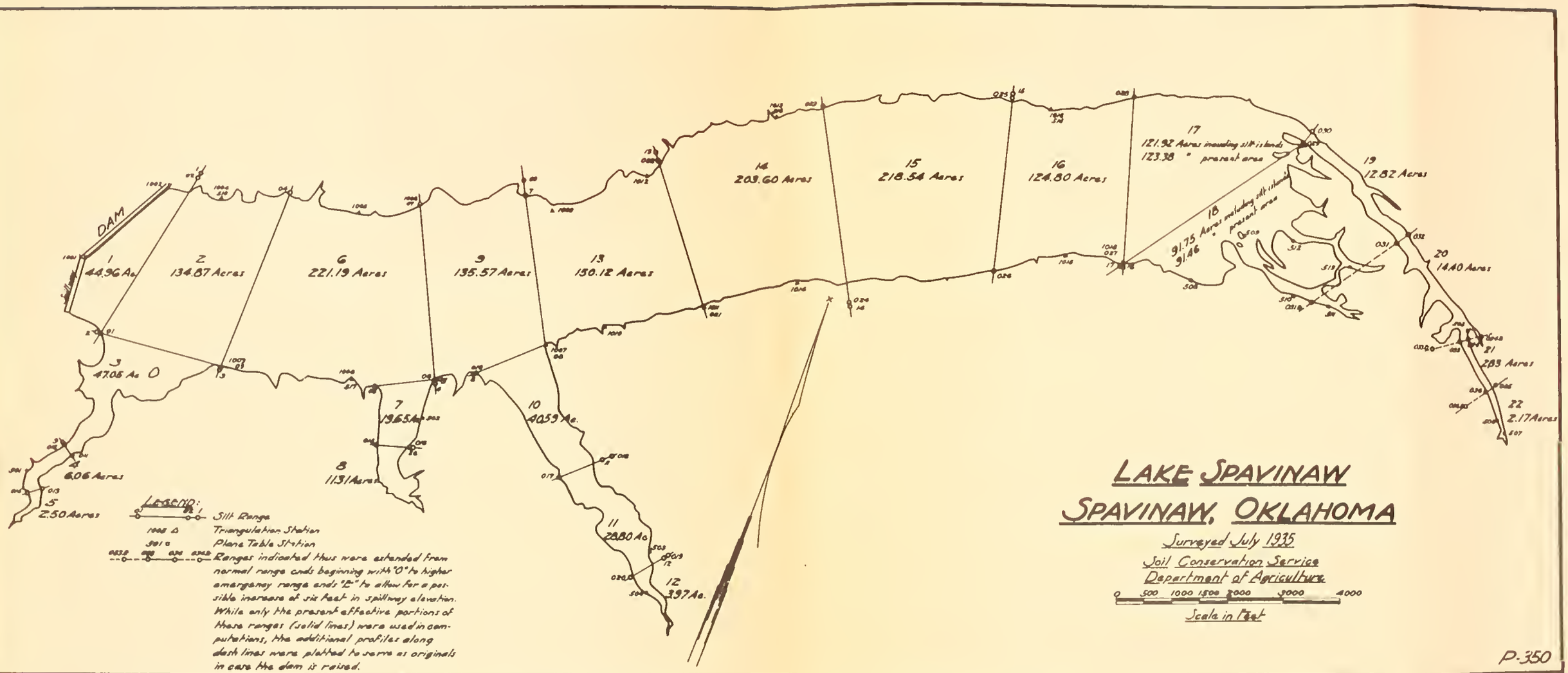
Silt deposits over most of the lake basin occur as a blanket of rather uniform thickness and consistency. From the dam up to Range 027--28, (See attached map), the average silt thickness is less than one foot. On Range 027-028 the average thickness is slightly more than 1.5 feet. This range is located just below the toe of the delta, which on this lake occupies Areas 17 and 18. Range 027-029 shows an average silt thickness of 2.73 feet in comparatively shallow water. The swampy embayment (Area 18) above this range was checked with spud and auger and the results disclose that the silt thickness diminishes regularly from the range to the edge of backwater. The islands present, with the exception of the largest one, are built up of sediment.

Most of the channel portion of the lake above Area 18 is free of sediment because of strong current action during flood stages of the stream, which results in sediment of this section being swept further down the reservoir, notably into Area 17.

Table 1.--Statistical summary of data relating to LAKE SPAVINAW, SPAVINAW, OKLAHOMA.

	Quantity	Unit
Age:[1/]	11	Years
Watershed:		
Total area	400	Square miles
Reservoir:		
Original area at crest stage	1,800	Acres
Present area at crest stage	1,637.64	
Original storage capacity	31,686	Acre feet
Present storage capacity	30,509	Acre feet
Original storage per square mile of drainage area	79.22	Acre feet
Present storage per square mile of drainage area	76.27	Acre feet
Sedimentation:		
Delta deposits	401	Acre feet
Bottomset beds	776	Acre feet
Total sediment	1,177	Acre feet
Accumulation per year average	107.07	Acre feet
Accumulation per year per 100 square miles drainage area	26.77	Acre feet
Accumulation per year per acre of drainage area	18.22	Cubic feet
Or, assuming average weight of 1 cubic foot of silt is 100 pounds	0.911	Tons
Depletion of storage:		
Percent loss of original capacity per year	0.338	Percent
Percent loss of original capacity to date of survey	3.72	Percent

1/ Date storage began April (?) 1924. Date of survey July 1935.



LAKE SPAVINAW
SPAVINAW, OKLAHOMA

Surveyed July 1935
Soil Conservation Service
Department of Agriculture

0 500 1000 1500 2000 3000 4000
Scale in Feet

P-350

U.S. Soil conservation service. Division of research.
Report on sedimentation survey...